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AND

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History of Astronomy—its various Systems, &c. [Concluded from page 266.]

OF THE QUANTITY OF MATTER IN THE SUN AND PLANETS, AND THE FORCE OF GRAVITY AT THEIR SURFACES.—On first view it almost appears impossible to determine the respective masses of the sun and planets, and to measure the height from which bodies fall in a given time, by the action of gravity at their surfaces. But the connection of facts with each other often leads to results which appear inaccessible when the principle on which they depend is unknown.

It was therefore perfectly natural, even for astronomers, to consider it impossible to determine the intensity of gravity at the surfaces of the planets, while the principle of universal gravitation remained unknown;* and it is just as natural for those who are unacquainted with mathematics and astronomy to consider the same thing impossible, even although they have heard of such a principle as universal gravitation. We shall therefore state what has been the result of the calculation of some of the first rate astronomers of the present day on this curious and interesting subject.

From the fact that action is always accompanied by re-action, astronomers conclude that gravitation among terrestrial bodies is the mutual tendency of the particles of matter to one another; and, from analogy, they think it perfectly reasonable to suppose that this is true in all cases; and that the force of gravitation towards different bodies, the distance being the same, is proportional to the quantities of matter, or the masses of the bodies.

This supposition is the foundation of all the calculations respecting the masses of the planets; and from it formulas have been deduced, for calculating the relative quantity of matter in such of the primary planets as have satellites revolving round them; but the quantity of matter in those that have no satellites can only be guessed at by the effect they produce in disturbing the motions of the other planets.*

The quantity of matter in the moon, however, may be determined by comparing its influence with that of the sun in producing the tides, and the precession of the equinoxes. By these means it has been ascertained that the mass of the moon is about one seventieth part of that of the earth; and La Place, in his *Mecanique Celeste*, has determined the quantity of matter in each of the primary planets, from the most exact data, to be as follows:

Quantity of matter in the Sun	1
Mercury	$\frac{1}{2025810}$
Venus	$\frac{1}{383137}$
The Earth	$\frac{1}{3296\ 36}$
Mars	$\frac{1}{1940682}$
Jupiter	$\frac{1}{1067.09}$
Saturn	$\frac{1}{3359.4}$
Uranus†	$\frac{1}{19364}$

The masses of the planets being known, and their bulks being also known, their densities are easily determined, for these are proportional to the masses divided by the bulks.

La Place, taking the mean density of the sun as *unity*, finds the density of such planets as have satellites to be as follows: The Earth, 3·9395; Jupiter, 0·8601; Saturn, 0·4951; Uranus, 1·1376.

Knowing the masses of the planets and their diameters, the force of gravity at their surface may be determined; for, supposing them to be spherical, and to have no rotation on their axes, the force with which a body placed on their surface gravitates to them will be proportional to their masses divided by the squares of their diameters. From the masses of Jupiter and the Earth, La Place calculates that a body which weighs one pound at the earth's equator, if carried to Jupiter's equator would weigh 2½ pounds, sup-

* It was this discovery which rendered it practicable to measure the intensity of gravity at the surfaces of the planets.

* The quantities of matter in any two primary planets are directly as the cubes of the mean distances at which their satellites revolve, and inversely as the squares of their periodic times.

† By adding these fractions together, it will be found that the quantity of matter in all the planets together is not one six-hundredth part of the matter in the sun!

posing these bodies to have no rotation, and supposing the weights to be measured by the pressure exerted in the two situations. If the same body were carried to the surface of the sun, it would weigh about $27\frac{3}{5}$ ponnds; from which it follows, that a heavy body would there descend about 444 in the first second of time.

Although all the planets gravitate to the sun, yet the centre of the sun is not the centre of gravity of the whole solar system. The centre of the sun is, however, never distant from that point so much as his own diameter, consequently the centre of gravity of the whole system is always within the body of the sun. But as this point and the centre of the sun do not coincide exactly, and as the gravitation of the planets to the sun must be accompanied by the gravitation of the sun to the planets, from the quality of action and re-action, it follows that the sun must have a motion in a small orbit round the centre of gravity of the whole system. The form of this orbit is however very complicated, on account of the disturbing forces of so many planets, which are sometimes exerted towards one side, and sometimes towards another; and even unequally exerted on different sides at the same time, according to the situation of the planets in their orbits.

Thus we see the extraordinary and universal principle called gravitation has not only been the means of making us acquainted with a great number of inequalities in the motion of the heavenly bodies, which it would have been impossible to have discovered by observation, but it has furnished us with the means of subjecting these motions to precise and certain rules.

The motion of the earth, which had obtained the assent of astronomers, on account of the simplicity with which it explained the celestial phenomena, has received a new confirmation, which has carried it to the highest degree of evidence of which physical science is susceptible. Without the knowledge of this universal principle, the ellipticity of the planetary orbits—the laws which the planets and comets obey in their revolution round the sun—their secular and periodical inequalities—the numberless inequalities of the moon, and the satellites of Jupiter—the precession of the equinoxes—the mutation of the earth's axis—the motions of the lunar axis—and the ebbing and flowing of the sea,—would only be insulated facts, and unconnected phenomena. It is, therefore, a circumstance which can scarcely be sufficiently admired, that all these phenomena, which at first sight appear so unconnected, should be explained by *one principle*—that of the mutual gravitation of all bodies with forces directly as their quantities of matter, and inversely as the squares of their distances.

Of the principal Systems of Astronomy.—After the description which has been given of the various phenomena of the heavens, both as viewed with the naked eye and the telescope, it may not be unnecessary, nor unacceptable to the reader, to give a short account of the principal theories or systems which have been formed at various periods to account for some of these appearances, and particularly for the apparent motions of the celestial bodies.

The explanation of the celestial motions which naturally occurred to those who began the study of the heavens, was, that the stars are so many luminous points fixed in the surface of a sphere, having the earth in its centre, and revolving on an axis passing through that centre, in the space of twenty-four hours. When it was observed that all the stars did not partake of this diurnal motion in the same degree, but that some were carried slowly towards the east, and that their paths estimated in that direction, after certain intervals of time, returned into themselves, it was believed that they were fixed in the surfaces of spheres which revolved westward more slowly than the sphere of the fixed stars. The spheres were supposed transparent, or made of some crystalline substance, and from this arose the name of the crystalline spheres, by which they were distinguished. Though this system grew more complicated as the number and variety of the apparent phenomena increased, yet it was the system of Aristotle and Eudoxus; and, with few exceptions, of all the philosophers of antiquity.*

But when the business of observation came to be regularly pursued, little was said, either of the fixed stars or of the crystalline spheres; astronomers being chiefly bent on ascertaining the laws or general facts connected with the motions of the planets.

To do this, however, without the introduction of hypotheses, at this period, was scarcely possible. The simplest and most natural hypothesis was that the planets moved eastward in circles, at a uniform rate. But when

* Although it is said that Pythagoras taught that the earth was a planet, and that the sun was fixed in the centre of the planetary system, that the apparent revolution of the heavens was produced by the diurnal revolution of the earth, and that the apparent annual motion of the sun was occasioned by the earth moving round him like the other planets, yet this doctrine was never taught publicly, and in a very short time it was completely forgotten.

it was found that, instead of moving uniformly to the eastward, every one of them was subject to great irregularity, the motion eastward becoming slower at certain periods, and at length vanishing altogether, so that the planet became stationary, and afterwards acquiring a motion in the contrary direction, and proceeded for a time to the westward, it was far from obvious that all these appearances could be reconciled with the idea of a uniform circular motion.

The solution of this difficulty is attributed to Apollonius Pergæus, one of the most celebrated mathematicians of antiquity. He conceived that each planet moved in a small circle, and that the centre of this small circle moved in the circumference of a large circle, which had the earth for its centre. The first of these circles was called the *epicycle*, and the second the *deferent;* and the motion in the circumference of each was supposed uniform. Lastly, it was conceived that the motion of the centre of the epicycle in the circumference of the deferent, and likewise the motion of the planet in that of the epicycle, were in opposite directions, the first being towards the east, and the second towards the west. In this way the change from progressive to retrograde, as well as the intermediate stationary points, were readily explained.

But, notwithstanding the accomplishment of this important object, no regular system of astronomy appears to have been framed or taught by any individual till the appearance of the celebrated Ptolemy, who has always been reckoned the prince of ancient astronomers, not so much on account of being the founder of the system which goes by his name, as for the number of observations which he made, and the extent of his astronomical writings.

As we have already given an account of this, as well as the Tychonic and Copernican systems, at page 189, vol. ii., we shall conclude this subject by giving a short description of the Cartesian system.

Cartesian System.—The founder of this system, Rhene Des Cartes, flourished about the beginning of the 17th century. He supposed that every thing in the universe was formed from very minute bodies, called *atoms*, which had been floating in open space. To each *atom* he attributed a motion on its axis, and he also maintained that there was a general motion of the whole universe, round like a *vortex*, or whirlpool. In the centre of this vortex was the sun, with all the planets circulating round him at different distances; those that were nearer the sun circulating faster than those at a greater distance, as the most distant parts of a vortex or whirlpool are known to do. Besides this general vortex, each of the planets had a particular vortex of its own, by which its satellites, if it had any, were whirled round, and any other body that came within its reach.

This is the celebrated system of vortices, invented by Des Cartes. The fabric, it must be confessed, is raised with great art and ingenuity, and is evidently the produce of a lively fancy and a fertile imagination. But then, it can be considered only as a philosophical romance, which amuses without instructing us, and serves principally to show that the most shining abilities are frequently misemployed.

In this hypothesis, Des Cartes supposes extension to constitute the essence of matter, and wholly neglects *solidity*, as well as the *inertia* by which it resists any change in its state of motion or rest, which principally distinguishes body from space; and consequently, the doctrine of an universal plenum, deduced from this definition, is founded upon false principles.

That there is such a thing as a vacuum in nature, or a space void of body, may be demonstrated from various experiments. By means of the air pump, we can so far exhaust the air from a glass receiver, that a piece of gold and a feather, let fall together from the top of the vessel, shall both descend equally swift, and come to the bottom at the same time: which evidently shows, that the air being taken away, there remains no other matter sufficient to cause any sensible resistance, or that in the least impedes or obstructs their passage.

It was said by many of the ancient philosophers, that nature abhors a vacuum; and by means of this dogma, and others of a like nature, they attempted to prove and illustrate the doctrine of an universal plenum, like that of Des Cartes. But this is an assertion, unsupported by facts, and too idle a notion to require any formal refutation; and in nearly the same predicament are most of the other arguments which have been used in defence of this doctrine. They are all sufficiently exposed, not only by the Torricilian experiment, and the nature of pumps in general, but likewise from the most obvious phenomena of the constant and free motion of bodies, whether celestial or terrestrial, which come continually under our inspection.

On the system of Des Cartes, and all others that depend on the same principle, we may remark, that if the planets be carried round the sun in vortices, the quantity of matter in the sun cannot affect the velo-

city of the vortex, or the bodies immersed in it; consequently the velocity might be the same, though there were no central body whatsoever. The quantity of matter in the sun, therefore, cannot have the least effect in retaining the planets in their orbits. But the quantity of matter in the sun does not affect the planet, and is a material element in its gravitation towards the centre of its orbit. It is therefore impossible that the action of a vortex can have any effect whatever upon that gravitation. This argument is perfectly conclusive and fatal to the system of vortices; but we may observe, that this system owed its downfall to another argument, equally, if not still more powerful—namely, that whenever you suppose the vortex so arranged that it will explain one of those great facts in the planetary motions, known by the name of Kepler's Laws, it becomes quite inconsistent with the rest.

The vortices of Des Cartes have, therefore, ceased to afford any satisfaction, even to the most superficial reasoner, and are now only known in the history of opinions, in which they will ever furnish a most instructive chapter.

[From the Journal of the Franklin Institute.]

Report on Mr. Peck's Method of Propelling Boats.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the mechanic arts, to whom was referred for examination a Plan of Propelling Boats, invented by Mr. J. Peck, of Oakland, Jefferson county, Tennessee, report—

That the inventor proposes to employ what he terms a *multiplied crank*, attached to an axis made to revolve horizontally by some power not indicated in the sketch before us. The several wrists of the compound crank are to have either setting poles or hooks attached, one to each wrist, which poles or hooks are to act successively in urging the boat forward, by applying, when poles are used, to the bottom of the canal or stream, and when hooks are substituted, to a rack, or rope, extending the whole way on the shore. Coiled springs are to be placed in some part of each pole, to prevent the effect of sudden and violent impulses. When the pole is used to apply to the bottom, a species of foot, made of three or four strips of metal, attached by hinges to the lower end of the pole, are to spread out and present a large surface to the soft bottom of the stream, to avoid sinking deep into the mud.

The slight sketch in the hands of the committee does not show any provision for guiding and directing the poles, nor obviate the difficulty from unequal depths on the two sides of the boat, when poles are used on both sides.

The method appears less suited to a railway than the rack-rail already in use, in connection with toothed wheels, to insure the advancement of locomotive engines.

It seems unlikely that this plan will supersede the more simple methods already used for propelling boats, unless under very peculiar circumstances, and with some arrangements for obviating the practical difficulties which are not indicated in the sketch before us. By order of the committee.

WILLIAM HAMILTON, Actuary.

March 13, 1834

Report on Mr. B. Dugdale's Wind-Mill.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the mechanic arts, to whom was referred for examination a Horizontal Wind-mill, invented by Mr. B. Dugdale, of Burlington, N. J., report—

That the machine in question consists of an upright shaft revolving on a pivot in a step at its lower end, from which shaft, near its upper extremity, proceed, in one horizontal plane, ten equidistant arms; and from near the middle of the same shaft, proceed ten corresponding arms, also in one horizontal plane. Between each pair of corresponding arms, oblong rectangular frames of wire are hung, (at the extremities of the arms,) in such a manner as to admit of a horizontal vibration, through an arc of about ninety degrees. To these frames the sails are attached by small rings of wire, which can slide up and down the vertical bars of the frames.

The operation of raising the sails is performed by means of cords, one of which is attached to the stretcher at the upper end of each sail, and passes through a pulley at the extremity of the upper arm, along that arm to the shaft, and down the shaft to a collar sliding on the same. When this collar, to which all the cords are attached, is depressed on the shaft by means of a lever, all the sails are raised simultaneously. Again, when the collar is elevated, the cords become slack, and the sails drop by their own weight.

The vibratory motion allowed to the frames which support the sails, is so regulated that the sails on one side of the shaft present their surface to the wind while those on the opposite side offer their edges only: the ef-

ficiency of the machine is due to this arrangement.

Your committee deem it unnecessary to expatiate upon the merits of this wind-mill, or to discuss the patentee's claim to originality in his invention; but will merely refer all who are interested in the subject to the Repertory of Arts, and to the Edinburgh Encyclopædia, in which they will find described several mills operating upon the same principle, some of which closely resemble this one in the details of their construction. By order of the committee.

WILLIAM HAMILTON, Actuary.

March 13, 1834.

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Report on Mr. Smith's Compass Needle.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the mechanic arts, to whom was referred for examination an Improved Compass Needle, manufactured by Mr. —— Smith, of Washington City, report—

That they have examined the needles submitted to them for that purpose by Mr. Trotter, together with the pamphlet of Mr. Smith, entitled "An Improvement," &c. and the notice of the patent for this improvement in the Journal of the Franklin Institute.

The claims in regard to the needles appear to be—

1. To a method of magnetizing them by percussion with what is called an electric rod.

2. To the removal of the influence of irregular magnetic distribution, and of local attraction, by "shifting feeders."

In regard to the particular method used by Mr. Smith, of conferring magnetism by percussion, the committee have no precise information, the needles not having been presented for their examination by the inventor himself, and no adequate description having been published of the details of his method. The general fact is well established in science, and testimony from various quarters speaks well of the application of it by Mr. Smith. Respecting the efficacy of the small pieces of soft iron, termed "feeders," shifting upon the magnet, and usually placed near the poles, the committee inquired and refer to the subjoined experiments for the data upon which their opinion has been formed. In these experiments they avail themselves of the kind assistance of Prof. Henry, of Princeton, who was, at the time they were making them, on a visit to our city.

The first object was to ascertain whether the feeders added to the intensity of the magnetic force in the needle.

For this purpose, the needle, furnished with its feeders drawn out to the marks on the ends, was suspended by a bundle of fibres of raw silk, free from twist. It was placed over a divided circle, that its deviation from the magnetic meridian might be observed. Drawing it out of that meridian it was made to vibrate, and the vibrations noted, when they had diminished so as to reach a certain extent. The mean of one hundred and twenty vibrations gave for the time of ten vibrations 80·47 seconds.

The weight of the magnet furnished to the committee was, without the feeders, 532·1 grains. The feeders weighed together 13·9 grains.

For these iron "feeders," two pieces of brass, of nearly the same weight and form, were substituted, that the mass of the needle might remain the same; the brass pieces were placed in the position formerly occupied by the feeders, and the needle was then vibrated.

The brass feeders were lighter than the iron ones by ·1 grain. From two series of experiments of one hundred and twenty each, the time of performing ten vibrations in this latter case was 79·87 seconds.

By the well known law expressing the relative horizontal intensities of the magnetism in these two cases,—namely, that the forces are inversely as the squares of the time of vibration,—the intensity in the first case was to that in the second as $79{\cdot}87^2$ to $80{\cdot}47^2$, or as ·98 to 1.

The force of the magnet, instead then of being increased by the feeders, is slightly diminished by them. Your committee must observe here, that it seems to them that this result is what should have been expected from placing a piece of soft iron within the poles of the magnet.

The next point to be examined was the efficacy of the "feeders" in preventing the effects of local attraction. This might be inferred from the results just given, but the committee preferred to subject it to direct experiment.

The same needle before used was placed upon a steel point, fixed in the centre of a graduated circle. A mass of soft ironwas brought to a measured distance from the needle, when the "feeders" were on; the deflection produced was noted; the "feeders" being removed, the deflection produced by the same mass in the same position was ascertained. These experiments the committee did not consider susceptible of the

same nicety which was used in the first inquiry. The piece of iron was a rectangular plate, nineteen and three eighths inches long by six and three eighths wide, and weighing twenty-four pounds. The following results were obtained, and may be considered to approximate within about one quarter of a degree of the truth.

When the iron plate was placed with its longest side making an angle of about forty degrees with the axis of the needle,—the least distance from the south pole of the needle, six inches,—with the "feeders" on, the deflection was 18¾°; with the brasses on, the deflection was 19°. The plate was now brought to half the distance above stated: With the "feeders" on, the deflection was 31¼°; with the brasses on, 31¾°.

The proportional difference in the deflections with the feeders on and off, is, in the first case, one in seventy-six, and in the second, one in about sixty-four. These numbers are to be considered as merely approximate, but they serve to show that the needle is less deflected with the "feeders" on, than when they are off, a result agreeing with the conclusions to be derived from the first experiments, which showed that the magnetism was weakened by the "feeders." If the magnetism had been entirely destroyed, the deflection would have been nothing. The needle subjected to experiment was, in fact, a very weak magnet, and the feeders made it still more feeble.

In the Transactions of the Irish Academy for 1788, a plan is proposed "to preserve the magnetism, and consequently the *polarity*, of the needle," by having it "cased with thin, well polished, soft iron, or else to have it armed at the poles with a bit of soft iron." Capt. O'Brien Drury, by whom this suggestion was made, modestly submits his invention to the judgment of those who are qualified to appreciate its merits, and we conceive that this judgment may be considered to have been formed by the neglect of the invention during the forty-six years which have elapsed since its publication. In the plan before the committee, the needle is not entirely cased, but is furnished with shifting bands of soft iron.

By order of the committee.

WILLIAM HAMILTON, Actuary.

March 13, 1834.

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Report on Mr. W. Henderson's Chart of Commercial Weights.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the mechanic arts, to whom was referred for examination a Chart of Commercial Weights, submitted by Mr. William Henderson, of Philadelphia, Penn., report—

That this chart comprises scales of comparison of the weights of the principal commercial cities of Europe, and other parts of the world.

Scales of the ancient weights of France and Holland, being those most generally referred to in books of science, are also given.

On the left of the scale the names of the countries or cities are printed, and also the denomination of weight into which the scales are divided, as pound, rotoli, kilogrammes, &c. &c.

The divisions on the scales are numbered at every ten.

For facilitating the comparison of weights of different countries, meridional lines are drawn across the scales at convenient distances.

Where different weights are used in the same country, different scales are for the most part given, as in the United States of America, one scale is given of pounds troy, and another of pounds avoirdupois. The troy scale extends from 0 to 219 pounds, and the avoirdupois scale from 0 to 179 pounds; and, within this compass, the comparison of weights of different countries is made by taking equal distances on the respective scales, from 0, or from the nearest meridional line, to the weights given and required.

The committee are of opinion that the chart of Mr. Henderson will be found useful in commercial establishments, but would recommend that the meridional lines should be made to correspond with definite divisions of the avoirdupois scale, as by that arrangement the comparisons could be made by a simple inspection of the chart.

By order of the committee.

WILLIAM HAMILTON, Actuary.

April 9, 1834.

WORMS IN THE BLOOD.—Dr. Bushman, a respectable surgeon of the Dumfries Dispensary, has published a remarkable account of a boy under his immediate care, eight years old, whom he bled in consequence of a severe pain in the head; and in the blood taken from the patient's arm, *fifteen worms* were discovered. They varied from half an inch to eight lines in length. The body was articulated, and had seven joints. It was the opinion of Mr. Rhind, a naturalist, that they corresponded in color, size, and structure, to the *Tipula oleracea*, which is found in ditch or river water.—[Scientific Tracts.]

We insert the following communication with much pleasure, as it refers to a subject which has been frequently treated of in this Journal. It will, we hope, elicit further information from American engineers, and we again call upon them to furnish us with the result of their reflections and investigations. —[Ed. R. J.]

On Railroad Undulations. By John Thomson, Civil Engineer, Nashville, Tenn.

To the Editor of the Railroad Journal.

Experiments have been made on the Liverpool and Manchester Railroad, by Mr. Badnall and others, for the purpose of showing the advantages of undulations on railroads. These experiments, and the results attempted to be deduced from them, are well known to engineers. The principles which Mr. Badnall attempts to deduce from these experiments have been considered visionary by many practical and scientific men. The question has attracted greater attention in England than in this country. The system has found its supporters and its opponents, who not unfrequently have employed ridicule and sarcasm instead of cool and rational argument.

It must be confessed, that the experiments above alluded to are not satisfactory. They seem to prove too much; as we ought to conclude from many of those experiments, that a car passing over an undulating road would acquire an additional velocity at every undulation, and would thus be moved by a kind of accelerating force as long as the undulations continued. The results of the experiments also are not sufficiently uniform, and indicate something defective in the mode of making the experiments. We may add, also, that Mr. Badnall has not been successful in his theoretical deductions. We may quote for example the following:

"Let P be the pressure or weight of a given body resting on a horizontal plane, and let S be the quantity taken off that pressure, (or let it be the diminution of pressure,) when the body is placed on an inclined plane, and let a be the angle of inclination with the horizon; we then have in *all cases*

S : P : : height : base.

But, height : base : : tang. a : 1

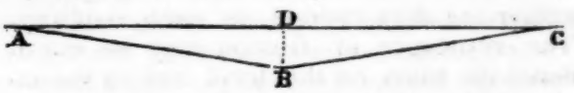
therefore, S : P : : tang. a : 1

consequently, S = P tang. a."

That this conclusion is erroneous may be shown by supposing a body of a given weight to be supported on an inclination of 45 deg. In that case we have tang. $a = 1$, and consequently the above equation becomes S = P, that is, the diminution of pressure is equal to the whole weight of the body, and therefore the body rests on the plane without pressure upon it, which is manifestly an error.

But, notwithstanding, there is enough in the experiments of Mr. Badnall, and in the nature of the subject generally, to invite the attention of engineers. That a body may be passed from one point to another, in the same horizontal plane, along a descending and an ascending path, in a shorter time than another body, moving in a straight horizontal line, and impelled at first by the same horizontal force, is true in theory, and no mathematician would controvert a principle so well known in mechanics. But whether the same will hold in practice, where the resistance of friction and of the atmosphere, &c. are to be taken into consideration, remains a question.

In further remarking on this subject, we shall adopt particular examples, which will perhaps answer the purpose of the present investigation better than a more general method.



Let A B and B C be two inclined planes, meeting at the point B, and suppose the length of each to be 954 feet, the height B D 9 feet, the descent will therefore be 1 in 106, or 50 feet in the mile nearly. The distances along the inclined planes C B A, and along the straight line C D A, will be nearly the same, and equal to 1908 feet. Put g = force of gravity, f = any other accelerating force, t = time, v = velocity, and s = space.

Suppose a body at C to pass from C to B by the force of gravity, without resistance of any kind from friction, &c. the time of descent will be $t = \sqrt{\frac{2s}{f}} = 79{\cdot}2$ seconds, and the time in passing along the two planes C B, B A, will consequently be 158·4 seconds, supposing the angle at B slightly rounded. It is evident that the body at C may be removed in this way from the point C to A, without the application of any other force than that of gravity. Let us now suppose the body to be removed from C to A along the straight line C D A. To do this, either an impulsive or an accelerating force will be necessary, the force of gravity, of course, not acting in this direction. To find the amount of accelerating force that will move the body from C to A along the straight line, in the same time that it passes along the inclined planes, we have $f = \frac{2s}{t^2} = {\cdot}152$.

If we assume the weight to be removed 100 tons, the above force, compared with the force of gravity, will be expressed by 1057 pounds. This will be the accelerating force necessary to overcome the vis inertiæ of the above weight, so as to move it in a straight line from C to A, in the same time that it would pass by the force of gravity along the inclined planes. If we assume the resistance of friction of rail cars equal to the 240th part of the weight, the friction from a weight of 100 tons will be 933 lbs. Hence it is evident, that to overcome for the above space and time the vis inertiæ of a train of cars weighing in all 100 tons, it will require a greater force than that necessary to overcome the resistance of friction.

Let us now assume a case in practice: suppose two trains of cars to pass by locomotive power from C to A, one train along the inclined planes, the other along the horizontal plane A D C. Here a variety of accelerating and resisting forces are to be taken into consideration, and compared together, as they operate on each roadway. The resistance of friction may be considered the same on the level and on the inclined planes, since the pressure on an inclined plane, and consequently the friction, is as the cosine of inclination; and as the angle of inclination in the present case is very small, its cosine approaches very nearly to unity. The resistance of the atmosphere may also be considered nearly equal in both cases; at least, in practice, the difference is probably of little consequence. In regard to the resistance of inertia, the inclined plane has the advantage of the horizontal; as, on the former, it may be considered as overcome by the force of gravity. There is one resisting force operating on the inclined planes, which does not exist on the horizontal. It results from a change of direction from C B to B A; but as we have supposed the angle at B to be rounded, the only resistance will arise from an increase of pressure, and consequently of friction, in passing over the curve at B. Let us suppose the whole line C B A to be a circular curve, D B and D C the co-ordinates which are given. The radius of curvature will then be 50566 feet. And supposing an average velocity of 20 miles per hour, we have $f = \frac{v^2}{R} = \cdot 017$. If the weight moved be 100 tons, the above force, compared with the force of gravity, will be expressed by 118 lbs. This will be so much *additional weight* in passing the curve, and consequently the *additional* resistance of friction will be about one half pound. It is evident, therefore, that this resistance may also be neglected in comparing the advantages and disadvantages of the inclined and horizontal planes.

Let us now suppose the train of cars that move along the inclined planes to be propelled by a force of steam just sufficient to overcome the resistance of friction, atmosphere, &c. In that case we may suppose the whole mass to move (as in theory) without resistance, and by the force of gravity alone. The train would therefore move from C to A in 158 seconds, as above shown. But the same force of steam would not be sufficient to move the train along the horizontal plane, as the resistance of inertia for a given space and time was shown to be greater than that of friction. A slow progressive motion might be given to the cars by a small increase of the force of steam, but it would require more than double the force necessary to overcome friction, in order to move the train along C D A, in the same time with the train moving along C B A. It should also be observed, that the velocity acquired in passing along C D A in 158 seconds, is nearly 16½ miles per hour, when the velocity of a locomotive may generally be considered as nearly uniform. It is evident, therefore, that for the distance and inclination here supposed, and for *initial* movements, one concave undulation, (if it may be so called,) has the advantage of a straight horizontal surface.

Again, let us suppose a case in which a number of undulations may be taken into consideration. Let two bodies be supposed to move with equal and uniform velocities along the horizontal plane from E to C, one then passing along the inclined planes C B, BA, AK, the other passing along the horizontal line C G, the bodies moving without resistance from friction, &c. Assume the length and inclination of the planes the same as before, and let the initial uniform velocity from E to C be taken for example, $v = 6$, or 4 miles per hour nearly. Then, having f and s given, to find the time of passing down the inclined plane C B, we have $\frac{1}{2} f t^2 + v t = s$, from which $t = 61 \cdot 9$ seconds.

Hence the time in which the body passes along the two inclined planes C B A, will be 123·8 seconds. But the body moving along the horizontal plane C A, with the uniform velocity above given, will pass from C to A in 318 seconds, almost three times greater than the time of passage on the inclined planes. Now, suppose the angle at A to be

rounded, the body which moves along the inclined planes will pass the point A with the same original velocity with which it first started at E, because nothing has occurred to destroy that velocity. Hence it follows, that the body will pass the second equal concave undulation A K G in the same time it passed the first, and so on for succeeding undulations. It appears also that the *mean* velocity along the inclined planes, of the length and height already given, is nearly three times greater than that along the horizontal plane, the original impulsive force having acted *equally* on both bodies. It follows also that the mean volocity along the inclined planes, for a given number of undulations, is a constant quantity, and not an accelerated velocity. It is evident, also, that if the inclined planes had been reversed, that is, if C B had been an ascending plane from C, instead of a descending one, the motion of the body, moving along the inclined planes, would have been retarded in the same ratio that we have seen it accelerated; and hence the advantage of increased velocity is only gained by having the inclined planes below the general horizontal plane.

The above being true in *theory*, the question now presents itself—will the same principles hold in practice? It would seem, on a general view of the subject, that the action of the impelling and resisting forces, as they occur in practice, could scarcely be so *unequal* as entirely to destroy the advantages of inclined planes of moderate length and height. If models may be considered as giving any thing like correct ideas of practical operations, (and it must be confessed they are not always to be relied on,) any one may satisfy himself of the general truth of increased velocity, as above stated, by simply propelling two small rollers, of equal dimensions, with the same impulsive force, one to pass along a horizontal plane, the other along an undulating surface, which may easily be prepared for the purpose.

It is not at all inconsistent with the principles of dynamics, but in perfect accordance with them, that two bodies may be impelled horizontally with the same motive force, and yet one pass between two given points in the same horizontal plane in less time than the other body moving in a straight line. It is true, that a straight line between two points given in space is the line of quickest passage, when a single given force acts alone; but in the present question, two principal forces are always supposed to act —the motive force and the force of gravity.

In practice, the action of the force of steam is not always regular. When the piston has acquired a very rapid motion, the actual pressure of the steam in the cylinder becomes less, not so much from a difference of pressure in the cylinder and boiler, as from the fact, that steam is not generated with sufficient rapidity to keep up the usual pressure in the boiler. Hence it is, that when a locomotive passes down an inclined plane, the actual motive force of the steam will be lessened, when a very rapid velocity has been acquired near the foot of the plane. But it is altogether probable that, on planes varying from 800 to 1200 feet in length, and of an inclination of about 50 ft. in the mile, the average force of steam would be abundantly sufficient to pass a loaded train over a concave undulation, in less time than it would pass the same distance in a horizontal line, if we suppose the force of steam sufficient to give the train a velocity of 10 or 12 miles per hour on a *level* road.

But, in all cases in practice, care should be taken to adjust the length and height of undulations, so that the velocity acquired at the foot of the planes should not be greater than what might be deemed safer under all circumstances.

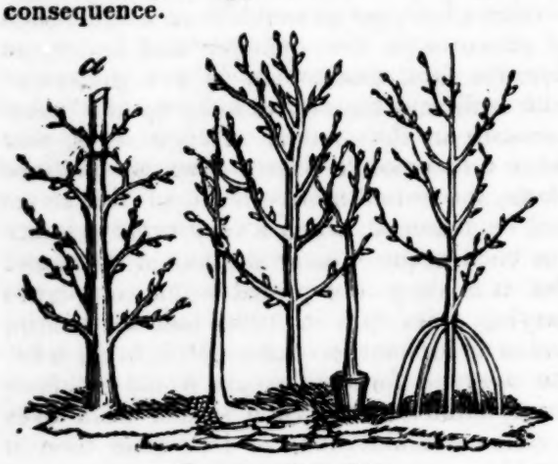
Upon the whole, *gentle* undulations, where the ground will permit, seem to be well calculated for steam or horse power. Much may be saved in the expense of grading, and water will always be prevented from lodging on the roadway.

In locating the planes for undulations, care should be taken so to adjust them, that a car, in passing over them, may first descend, and then ascend to nearly its former level. The nature of the ground in all places frequently permits this; for instance, in crossing a ravine, or small creek bottom, where the length of the planes may be from 100 to 300 yards. When it is necessary to extend the length of the planes to half a mile, or more, it is evident that the ascending and descending grades should be so adjusted, that the force of steam alone, and not momentum, may be depended upon, for passing the load up the ascending plane.

GRAFTING.—We copy the following from Prof. Rennie's little work on Scientific Gardening.

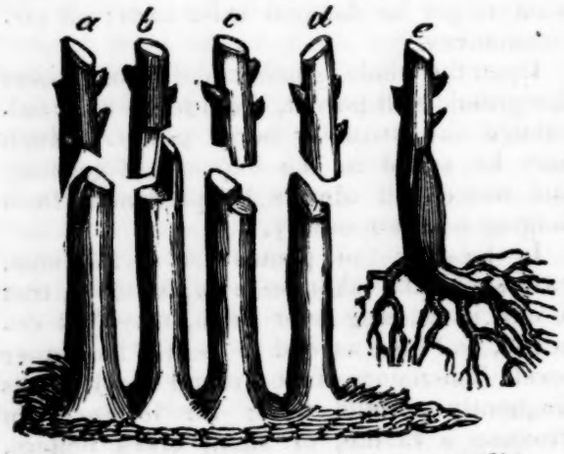
Grafting by Approach, or In-Arching.—This is to grafting what layers are to striking, the graft-slip not being cut off, but taken from a plant growing near the stock upon which it is suffered to remain till the joining is completed. Mr. T. A. Knight employed this mode, not only for the purpose of filling up from itself the parts of a wall-tree deficient in bearing wood, (*a*,) but also of improving the quality of fruits. It might be advantageously used in a similar way

to fill up the gaps in quickset and other hedges, where beauty of appearance is considered of consequence.

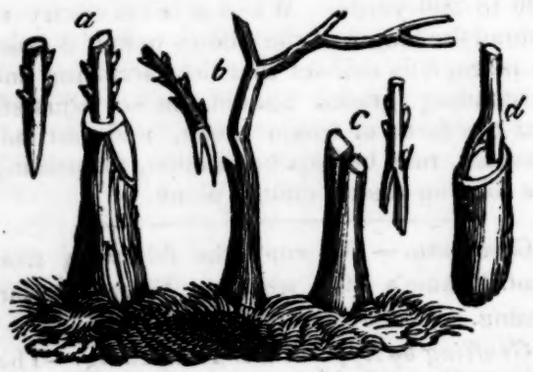


Examples of In-arching.

Slip, or Scion Grafting.—The slips taken off from one plant and joined to another, have the parts to be joined cut in various manners, according to the sort of plant, the size of the parts, and other circumstances. These will be better understood from the following figures, than from mere verbal description.



a, *b*, *c*, *d*, chink, or shoulder grafting; *e*, root grafting.



a, whip grafting with a peg; *b*, side grafting; *c*, whip grafting with a tongue, or tongue grafting; *d*, side grafting.

Professor Thouin has enumerated about fifty methods of grafting, but they all depend upon the same principles as already explained,

Bud Grafting, or Budding.—Instead of a slip, or scion, the bud of one plant may be so inserted into the bark of another as to grow, and produce branches, flowers, and fruit. It is requisite for this purpose that a leaf bud, known by its tapering sharp point, be selected, and not a flower-bud, known by its bulging and rather blunt point. It is necessary that the leaf connected with a bud be cut off, otherwise it would soon exhaust the sap, and the bud would wither and die. It is also necessary that the bark separate freely, which is the test for there being pulp enough to form a joining. When the bud is inserted, it must be tied round with a riband of bass, to exclude the air. Fine rose standards are thus formed.

Herb Grafting.—Though grafting is usually confined to trees, De Candolle thinks all plants may perhaps be capable of being so treated, and Baron de Tschoudy has in this way succeeded even with annual plants, as well as with the soft young shoots of trees; but it is necessary to success to have it performed near to or at the inner base of a living leaf, which serves to attract the sap.

In the case of plants with succulent leaves, it has been asserted, on authority, that "the union is imperfect," from the adhesion being "by the cellular substance" only, "no woody matter" being transmitted to the stock. That this is quite erroneous is shown by the striking instance of a Cactus truncatus grafted on a Cactus triangularis in the king's garden at Neuilly, as beautifully dissected and drawn by M. Turpin. This also equally disproves the common opinion that the graft in such cases is merely kept alive by the moisture supplied by the stock, and would do as well if stuck into a potato or a piece of moist sponge. It certainly furnishes a strong disproof of the baseless theory that maintains buds and grafts to send down woody matter to the stock, as roots descend into the soil.

Apparatus for analysing Marl, and the Carbonates in General. [From the Farmers' Register.]

William and Mary College, June 27, 1834.

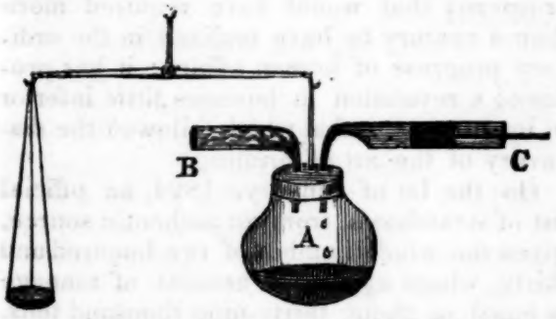
The apparatus which I am about to describe is intended to give greater accuracy and facility to the usual process for determining the quantity of carbonic in marl, or in any of the carbonates. By the common method, the two vessels containing severally the marl and the muriatic acid are placed in one of the scales of a delicate balance, and there counterpoised by weights put into the other scale. The acid is then poured upon the marl, and, after all the carbonic acid has been discharged, the equilibrium is restored by adding weights to one, or abstracting them from the other scale. In principle, this method is entirely free from objection, but as usually conducted, it cannot be relied upon as accurate. This want of precision arises in the first place from

the escape of aqueous vapor, along with the carbonic acid which is discharged, thus making a greater weight necessary for restoring the equilibrium than is due to the quantity of carbonic acid which has escaped —and secondly, from the greater weight of the vessels containing the marl and acid impairing the sensibility of the balance, and thus rendering it impossible to estimate the carbonic acid to small fractions of a grain. The first of these objections has long been obviated in the chemical analysis of the carbonates, by causing the gas as it escapes to pass through a tube containing dried muriate of lime; and the latter has been in some measure removed by a contrivance of the great practical chemist Rose; which, however, as it is inconvenient and uncertain in the manipulation, I shall not here describe.

The apparatus which I have devised is, I think, free from these objections, and enables the operator to proceed with great accuracy and despatch. It has the advantage of being very easily constructed, and of being used with a balance that can be procured at a very moderate price. Moreover, the quantity of marl which is necessary for experiment in no case exceeding ten grains, specimens for analysis may very easily be forwarded by letter.

The balance which I use with this apparatus is a small goldsmith's balance, such as may be procured for a few dollars in New-York. It is very light, and turns, when unloaded, with the one hundredth of a grain. My set of weights, obtained from Millington, in Philadelphia, extends to tenths and hundredths of the grain.

The accompanying figure will convey a distinct idea of the apparatus and mode of using it. One of the scales is removed, to admit of suspending the apparatus by a double thread over the hook of the beam. The other is made of something light, as a piece of card. In this way all unnecessary weight upon the beam is avoided, and its sensibility preserved.



A is a light bulb of glass, blown very thin, from a common piece of tube, and about one inch in diameter. A cork is fitted to its mouth, and through this the tapered ends of the bent glass tubes, B and C, are passed air tight; the extremity of the latter extending some distance into the vessel. The tube B, through which the gas escapes, is filled with fragments of muriate of lime. The tube C, which contains the muriatic acid, is furnished with a light piston of cork or cotton, in the centre of which is fixed a rod or handle, made of a small stiff straw. This instrument, when charged with marl and acid, does not weigh more than 120 grains. The whole load of the beam is therefore 240 grains, and it is still sensible to the one hundredth of a grain.

The mode of proceeding with the analysis is as follows. Five or ten grains of the finely powdered marl is introduced into the vessel A, and then two or three drops of water added, to assist the diffusion of the acid. The small end of the tube C, now removed from the cork, is dipped into some muriatic acid in a wine glass, and the piston moved backwards and forwards until the necessary quantity of acid has been drawn in. The tube is then replaced in the cork, and in this state the instrument is counterpoised by weights in the opposite scale. The piston being then gradually forced in, the acid is injected drop by drop upon the marl, and the gas escapes by the tube B, depositing the aqueous vapor in its passage on the muriate of lime. Allowing the apparatus to rest until the gas has entirely escaped, and the decomposition is complete, the equilibrium is restored by placing weights upon the clear top of the cork, or by removing weights from the scale. In this way the weight of the disengaged gas is accurately determined, and the proportion of carbonate of lime thence computed.

An analysis of a specimen of marl from James City, just completed, will serve as an illustration of the method. Ten grains of the finely powdered marl were introduced with a little water into the vessel A; the instrument was then charged and equipoised. The acid being injected, the whole was allowed to rest for an hour. The weight lost was 2·91 grains. Increasing this in the ratio of 44 to 100, gives 6·61 grains of carbonate of lime in the 10 grains of marl —or almost precisely 66 per cent.

The frequent calls upon me for the analysis of specimens of marl, first led me to the construction of this apparatus, and I have since found it so convenient and accurate, that I can recommend its adoption to such of your readers as may have a taste for chemical inquiries connected with agriculture. Any ordinary worker in glass will construct the

instrument, and skill in manipulating with it may be soon and easily acquired.

Wm. B. Rogers.

[The farmers who are using marl will be greatly indebted to Professor Rogers for the convenient and cheap little apparatus above described—which, judging from his description, not only furnishes the cheapest and most convenient, but likewise the most accurate mode of analysing calcareous manures. It may be easily constructed by any worker in glass—so easily, indeed, that Mr. Rogers made his own by the heat of an Argand lamp, using a few common glass tubes as materials. Every farmer who uses calcareous manures ought to have some means for testing their strength, and this seems to be completely within the power of all to obtain, and to make use of, with very little attention. But, though the process as above described is sufficiently plain to all who have the slightest knowledge of the chemical properties of the substances used, it may appear unintelligible to others; and therefore we hope that the following explanations may be pardoned by those to whom they are altogether useless.

The principle upon which the apparatus works is the same as that of the more expensive and complicated apparatus of Davy, (described in his Agricultural Chemistry,) which we have heretofore considered the best—that is, by separating and ascertaining the weight of the carbonic acid combined with the lime of the manure. Every hundred grains of calcareous earth, or carbonate of lime, is composed always of similar proportions of lime and of carbonic acid—which proportions, by weight, are 56 parts of lime, and 44 of carbonic acid. Of course, if we know how much weight is lost in 100 grains of earth, partly of carbonate of lime, (as marl,) by driving off its carbonic acid, the rule of proportion will show what was the amount of carbonate of lime contained in the sample of earth.

When the muriatic acid reaches the earth in the bulb, it immediately combines with the lime by its greater attraction, and the weaker carbonic acid is disengaged in the form of gas, and escapes into the air through the tube containing the dry muriate of lime —which substance attracts moisture so powerfully as to retain all that might otherwise pass out with the gas. The same muriate of lime will serve for many experiments, as by being heated in the tube its dryness is restored previous to every trial. This salt is formed by the combination of muriatic acid with lime, and therefore every experimenter may provide it for himself by filtering and evaporating the fluid left in this process of decomposing carbonate of lime.—Ed. F. Reg.]

Steamboats on the Western Waters.

In a publication made by the writer of this article in 1829, on the interesting subject of steamboats, it was calculated, that from the time of their first introduction on the western waters in 1811, until that period, their number amounted to about three hundred and twenty-three. Their united tonnage was estimated at fifty-six thousand tons. From the best data which could be procured from the most intelligent sources, the original cost of these boats was five millions six hundred thousand dollars, and the repairs on the same number, assuming that none of them would last longer than 1832, was set down at two millions eight hundred thousand dollars. Now, although there were five or six boats built between the years 1811 and 1817, the latter period may be assumed as the epoch of their regular and successful introduction; in 1825 they were brought to their present state of perfection. It results, then, that the amount expended for the building and repairing of steamboats, in a period of about eleven years, was equal to eight millions four hundred thousand dollars. As the number of steamboats was increasing annually, no fixed amount can easily be assumed for the yearly expenses; but for the year 1829, the sum was fixed at two millions five hundred thousand dollars; if, then, five hundred thousand dollars be considered as a fair yearly average from 1818, the total amount of money expended on the shores of the western waters, up to 1829, inclusive, will be little short of fourteen millions of dollars. When it is considered that this circulation and expenditure of money was exclusively created by the introduction of the steamboat, the importance of this invention to the valley of the Mississippi may be conceived. It has produced an advance of prosperity that would have required more than a century to have realized in the ordinary progress of human affairs; it has produced a revolution in business little inferior in importance to that which followed the discovery of the art of printing.

On the 1st of January, 1824, an official list of steamboats, from an authentic source, gives the whole number of two hundred and thirty, whose aggregate amount of tonnage is equal to about thirty-nine thousand tons. Allowing the cost of building at a rate much lower than the rule adopted three years since, the capital now invested in this stock

will exceed three millions of dollars. The expense of running may be put down nearly as contained in the following scale:

60 boats over 200 tons, 180 running days, at $140 per day, - -	$1,512,000 00
70 boats from 120 tons to 200, 240 running days, $90 per day, - - - - -	512,000 00
100 boats under 120 tons, 270 running days, $60 per day,	1,620,000 00
Total yearly expense,	4,644,000 00

This sum may be reduced to the different items producing it, in the following proportions, viz.:

For wages, 36 per cent., =	$1,671,840 00
Wood, 30 per cent. - -	1,393,200 00
Provisions, 18 per cent. -	835,920 00
Contingencies, 16 per cent.	743,040 00

This result is truly striking to those who were accustomed to the state of things on our rivers within twenty years. The difference in the amount of wages paid is in itself very considerable; but the item of fuel is one created exclusively by steamboats; and when it is considered that nearly one million and a half is expended every year at a few points on the Mississippi valley, it presents a vast field for speculation. The immense forests of beech and other timber, unfit for agricultural purposes, were, before, not only useless, but an obstacle to the rugged farmer, who had to remove them before he could sow and reap. The steamboat, with something like magical influence, has converted them into objects of rapidly increasing value. He no longer looks with despondence on the denseness of the trees, and only regrets that so many have already been given to the flames, or cast on the bosom of the stream before him.

At the present period, the steamboats may be considered as plying as follows, viz.:

25, over 200 tons, between Louisville, New-Orleans, and Cincinnati, meas'g	8484 tons.
7 between Nashville and New-Orleans, - - - - -	2585 do.
4 between Florence and New-Orleans, - - - - -	1617 do.
4 in the St. Louis trade, - -	1002 do.
7 in the cotton trade, - -	2116 do.
57 boats not in established trades, from 120 to 200 tons, - -	8641 do.
The balance under 120 tons in various trades, - - -	14,655 do.
	39,000

In the New-Orleans and Louisville trade, the boats over two hundred tons make about one hundred and forty trips, in prosperous seasons; those of smaller size make from fifty to sixty trips. But to go into an estimate of the number of voyages made by the boats in the different trades is impossible, because no regular data are furnished, and the result depends upon a variety of contingencies.

Previous to the introduction of the steamboat in 1817, about twenty barges, averaging one hundred tons, afforded the only facilities for transporting merchandise from New-Orleans to Louisville and Cincinnati. These making but one trip within the year, gave the means of bringing up only two thousand tons. The present tonnage in this trade exclusively having been stated to be 8484 tons, gives the amount employed, amounting to one hundred and forty trips in the season, to be 1,187,760 tons: a cause capable of producing a revolution in sixteen years hardly equalled in the annals of history. The effects of these causes upon western commerce have necessarily been immense. The moral changes alone are felt throughout the west, and the effect on prices is almost incalculable: the imported article has fallen in a ratio equal to the increased price of western products. In looking back to the old means of transportation, we cannot conceive how the present demand and consumption could have been supplied by them.

To those who are acquainted with the early mercantile history of our country, when it was no uncommon thing for a party of merchants to be detained in Pittsburgh from six weeks to two months by low water and ice, the existing state of things is truly gratifying. The old price of carriage of goods from the Atlantic seaboard to Pittsburgh was long estimated at from five to eight dollars for one hundred pounds. We have instances, in the last five years, of merchandise being delivered at the wharf of Cincinnati, from Philadelphia, by the way of New-Orleans, for one dollar per hundred.

It may not be useless or uninteresting to give an idea of the *mortality* among steambaats in a given time. It is not pretended that any decided inference can be drawn from this statement, or that the facts go to establish any fixed rule. But under the present situation of steamboat discipline and regulations, a tolerably fair conclusion can be drawn from it. Taking the period, then, of two years, from the fall of 1831 till that of 1833, we have a list of boats gone out of service of sixty-six: of these, fifteen were abandoned as unfit for service, seven were lost by ice, fifteen were burned, twenty-four snagged, and five destroyed by

being struck by other boats. Deducting the fifteen boats abandoned as unseaworthy, we have fifty-one lost by accidents peculiar to the trade. In number, this proportion is over twelve per cent. per annum; in tonnage, the loss is upwards of ten per cent. Amount snagged, 3721 tons; amount burned, 2330 tons.

The foregoing calculations and statements afford a great field for speculation. It is evident that there is a vast amount of surplus tonnage, and, of course, the business at present is entirely overdone. Indeed, from a full investigation of the subject, a few years since, by a committee appointed for the purpose, it was fully ascertained, that although the benefits conferred on the valley of the Mississippi were incalculable, the stock invested in boats was, as a general rule, a losing investment—in many cases, a total sacrifice. In a few cases, owing to a fortuitous combination of circumstances, money has been made; but the instances are so few as not to affect the rule. Time may correct this evil; but in a business in which public interest and public safety are so much concerned, a little governmental interference and assistance might be useful, and ought to be tendered. Some legislative action, which might tend to arrest the fearful increase of accident, has long been a desideratum; but how this is to be applied, presents the great difficulty. An experiment, however, has been tried, which seems to hold out the prospect of success. We allude to the company which was formed in 1832–3, called the Ohio and Mississippi Line of Transportation. During the existence of this company, not an accident of any kind occurred to person or property. A perfect regularity in arrivals and departures was introduced, and as all the good boats were in the same interest, there was no foolish rivalship, and consequently no injudicious racing. How far the post-office department would be justifiable in aiding such an association we do not pretend to say, but in our humble view of the case, we consider the great interests of the west are much involved in the question; and when the great uncertainty and irregularities of the mail, which have hitherto distinguished the routes between New-Orleans, Natchez, and St. Louis, and Pittsburg, Louisville, and Cincinnati, are considered, something is expected. On the score of economy alone, the subject is worthy of the reflection of the general government. Probably nine tenths of the correspondence on the western waters is of a commercial character; the greatest portion of this is now transmitted, free of postage, by means of passengers: no one can prevent this. If a line of steamboats can be made interested in protecting the government, the general post-office would find it to its advantage to give liberal terms to such an establishment. N.

[Western Magazine.]

Manufacturing Establishments at Cincinnati, Ohio, in 1834.

There are more "manufacturing establishments" in this city than in any city or town in the west. Pittsburgh ranks next to us in that respect, and perhaps is ahead of us, when we take into consideration the difference of population. Cincinnati has a third more inhabitants than Pittsburgh. We have twelve or thirteen foundries and engine factories, for the manufacturing of engines for steamboats, flour mills, grist mills, rolling mills, and for blast furnaces, used in this section of country, and for sugar mills, corn mills, cotton gins, saw mills, and other uses, for the south, where an immense amount is exported yearly. An estimate was made in 1832, for the year previous, of the amount exported of articles of the above description, and it exceeded $400,000.

We have also a large and extensive rolling mill, owned and conducted by Messrs. Shreve, Paull, and M'Candless, gentlemen of great enterprise, who employ about one hundred men; they cut some ten to eleven tons of nails per week. An extensive and complete spade and shovel factory; seven or eight bell and brass foundries, where an almost unlimited amount of work is done; twelve steam saw mills, all of which are conducted on a very large scale—at most of them there are machines connected for cutting laths, shingles, &c.—5 to 7000 laths can be cut in an hour. At some of these mills they have a saw for cutting boards and timber, a circular saw, and a machine for planing flooring boards, all driven by steam power.

Two flour mills, one owned by C. Bradbury, Esq., and driven by water from the canal—they make sixty or seventy barrels every twenty-four hours. Connected with this establishment is an oil mill, for the manufacturing of linseed and castor oils; there is also a mill connected for grinding and sifting corn meal, large quantities of which are barrelled and exported. Our largest and most extensive flour mills in this section of the state are on the Big and Little Miami rivers, which empty into the Ohio above and below this city, and are situated from ten to fifty miles from Cincinnati; they manufacture, some one hundred, some one hundred and fifty, and some two hundred barrels,

every twenty-four hours. All this flour is sent to this market by canal and waggons, and then exported to New-Orleans, the Atlantic cities, &c. The other flour mill in the city is worked by steam, and can manufacture, when in operation, one hundred and fifty barrels per twenty-four hours. I would stop here to remark, that there are about sixty steam engines in constant operation within the corporation lines, exclusive of those on our steamboats, and *all* high pressure; low pressure engines are not in good repute in the west.

A card manufactory, owned by M. P. Cassilly, Esq. where every description of machine cards are made. A large number of establishments for the manufacture of steam boilers, where hundreds of men are constantly employed. A stereotype foundry, and also a large and extensive type foundry, owned by N. Guilford, Esq. and others, where is manufactured every variety of type, printing presses, and every article connected with the printing business; there are eleven or twelve machines for casting type, and sixty to seventy hands are constantly employed; they manufacture to the amount of some 50 to $60,000 per year.

A steam fire engine factory, owned and conducted by Messrs. Chase and Seymour. The engines manufactured by them are equal for power, beauty, and workmanship, to any manufactured east of the mountains.

A patent lever lock factory, by Messrs. Shawk and Fitz.

A steel saw and file factory, by Messrs. Garrard & Co.

A printing press manufactory, on an extensive scale, by S. Dickinson.

A saddle tree manufactory, machinery driven by steam, conducted by Messrs. Kendall & Co.

A clock factory, by Lerman Watson, Esq. where are manufactured clocks, both of brass and wood. The establishment is a large one; many hands are employed, and many clocks made, of every description.

A factory for rolling sheet lead, and drawing lead pipes, by steam, for hydraulic purposes.

A steam stone saw mill. This establishment is worked on a new principle, and is patented to the proprietor, (Mr. Jas. Henderson.) It cuts stone with great accuracy.

A white lead manufactory, by steam power, owned by James M'Candless, Esq.

A bark and leather rolling mill, owned by the Messrs. Clarks, and worked by steam. The manufacture of malt liquors is carried on very extensively in the city, and to great perfection. There are eight very large breweries, and the beer, porter, and ale, manufactured by them, is equal to any I have ever seen in the eastern cities. We have a great number of snuff and tobacco manufactories, last factories, candle and soap factories, &c. Hats, furniture, &c. are manufactured in great quantities, and exported for sale to Kentucky, Tennessee, Mississippi, Louisiana, and every State south and west of us.

My limited information on the subject of manufactories, as well as want of time, will prevent me from giving you a more minute account of the manufacturing and mechanical business carried on to a very great extent, and to equally great perfection, in Cincinnati. I have named a few, and only a few, of the largest establishments, those that have come to my mind while writing; there are many others, where great numbers of hands are employed, that I do not at this moment think of. Opposite the city, at Newport, is a large cotton bagging factory. It is on a very extensive scale, owned by an incorporated company, with a capital of half a million. They manufacture bagging, bale rope, twine and cordage, Kentucky jeans, cotton and woollen coarse goods, sheet lead, and pipe—all of which is carried on by steam power. The machinery, when in full operation, will use annually 450 tons of hemp, 850 bales of cotton, 95 tons of wool, and 200 tons of lead. The agent resides and transacts all the business of this establishment in Cincinnati. There is also, in Newport, a steam saw mill.

In Covington, also opposite to this city, is a large cotton factory, owned by C. Macallister & Co. of this city; they run 2500 spindles, and manufacture 300,000 lbs. cotton yarn per annum. Sixty hands are employed. The yarn is sold here. There is also in Covington a rolling mill on a large scale, a rope walk, steam flour mill, and a steam saw mill.—[Patriot.]

MANUFACTORIES IN PITTSBURGH.—The various manufacturing establishments of Pittsburgh are thus briefly enumerated in a late number of the Gazette of that city.

There are, says that paper, in the city of Pittsburgh, 16 "foundries and engine factories" of the largest denomination, besides numerous other establishments of less magnitude.

There are 9 "rolling mills," cutting two tons of nails and rolling eight tons of iron per day, on the average, and employing from seventy to ninety hands each.

There are 6 "cotton factories", with an aggregate of twenty thousand spindles, one

hundred and sixteen power looms, and one hundred and seventy hands.

Six extensive "white lead factories."

Five extensive "breweries," besides small ones.

Six "steam saw mills."

Four "steam grist mills."

Ten extensive "glass works."

Upwards of one hundred "steam engines in full operation."

There are, moreover, innumerable establishments for the manufacture of ploughs, timber, wheels, screws of all kinds, saddle trees, machine cards, bells, brass work of every description, locks, &c. &c. all manufactured extensively for exportation.

Silver Mines of Barnaoule.—These are located on the confines of China, near the boundary between China and that country. There are thirty-two mines, wrought by eighty-two thousand persons, divided into three parties, so that the operations are never suspended night or day. The wages are very trifling. The whole of the silver is transported to St. Petersburg, for coining, and other purposes of the government.—[Scientific Tracts.]

A Sister's Love.—There is no purer feeling kindled upon the altar of human affection than a sister's pure uncontaminated love for her brother. It is unlike all other affections, so disconnected with selfish sensuality, so feminine in its developement, so dignified, and yet withal so fond, so devoted.

Nothing can alter it, nothing can suppress it. The world may revolve, and its revolutions effect changes in the fortunes, in the character, and in the disposition of her brother; yet, if he wants, whose hand will so readily swell his advocacy?

Next to a mother's unquenchable love, a sister's is pre-eminent. It rests so exclusively on the tie of consanguinity for its sustenance—it is wholly divested of passion, and springs from such a deep recess in the human bosom, that when a sister once deeply and fondly regards her brother, that affection is blent with her existence. In all the annals of crime, it is considered something anomalous to find the hand of a sister raised in anger against her brother. In all the affection of woman, there is a devotedness and strength which cannot be properly appreciated by man. In those regards where the passions are not at all accessary in increasing the strength of the affections, more sincere truth and pure feeling may be expected than in such as are dependent upon each other for their duration, as well as their felicities.

A sister's love in this respect is peculiarly remarkable. There is no selfish gratification in its outpourings; it lives from the natural impulse; and personal charms are not in the slightest degree necessary to its birth and duration.

The Christian Library—a weekly re-publication of the most popular religious works, under the superintendance of the Rev. Jonathan Going, Rev. John F. Schroeder, and Rev. John M. Krebs. Quarto, Nos. 1 to 19. Thos. George, Jr., 162 Nassau street, New-York.

Amidst the numerous cheap periodicals that are daily issuing from the press, we know of none more valuable, none more calculated to serve the best interests of society, than the one now under our notice. It places within the reach of our fellow citizens, for *three dollars* per annum, as much as could be obtained in the ordinary way for thirty or forty dollars, consisting of memoirs of most of the distinguished divines, such as Owen, Baxter, Doddridge, Martyn, Hall, &c., historical narratives of the progress of religion and civilization in all parts of the known world, and re-prints of the most valuable and popular productions of such eminent men as Leighton, Bickersteth, Bunyan, Edwards, &c. &c. Such a publication cannot fail to be an interesting and valuable appendage to every library, and may with confidence and pleasure be placed in the hands of the rising generation by every parent and guardian. We most cordially recommend it for its utility and economy, and, we may add, for the very superior manner in which the publisher issues it to his subscribers. The three first numbers contain the whole of the memoirs of Rev. H. Martyn; 4th, 5th, 6th, the whole of that admirable work by the late Hannah More, entitled "Practical Piety"; 11th, 12th, and 13th, the whole of Dr. Dick's Christian Philosopher; and the latter numbers contain the memoir of that distinguished and venerable, although eccentric individual, *Rowland Hill*, by his relative, the Rev. Edwin Sidney, together with other works of sterling merit.

The *Mechanics' Magazine and Register of Inventions and Improvements* is published by the Proprietors, D. K. Minor and J. E. Callis, at No. 35 Wall street, New-York: in *weekly* sheets of 16 pages, at 6¼ cents—in monthly parts of 64 pages, at 25 cents—in volumes of 384 pages, in cloth boards, at $1.75—or at $3 per annum, *in advance*.—John Knight, (formerly proprietor of the London Mechanics' Magazine,) Editor.